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Transforming Spectrum Management

By Thomas Kidd - April-June 2012

Emerging technology has always compelled traditional spectrum management processes to adapt and evolve. The 2012 International Telecommunication Union World Radiocommunication Conference issued new international radio regulation treaty language regarding software defined radio and cognitive radio systems.

During the coming months, the United States and each member nation of the International Telecommunication Union will begin incorporating the decisions made during the conference into their national regulatory processes. For the United States and other nations that seek to assure their communications license holders access to specific electromagnetic spectrum, these new technologies will challenge the stability of the current spectrum management business paradigm. For industry professionals who assure their customers access to the electromagnetic spectrum, the emergence of these new technologies also poses a challenge to the spectrum management process.

In a software defined radio, the software defines the characteristics of the radio, and software waveforms may be reused and ported onto different radio hardware similar to computer applications. Traditional hardware components are replaced with embedded computing devices.

Cognitive radio systems obtain knowledge and then adjust their operational behavior based on that information. While neither of these technologies is in widespread use today, they are already affecting the traditional concepts of equipment certification and frequency assignment.

There are several steps in the Department of the Navy's spectrum dependent systems development process during which the effects of the technology under development in the electromagnetic environment is assessed. The system is certified to function without harming its intended operational electromagnetic environment or exceeding a rigid set of operational criteria. Once deployed, radio frequencies are assigned to that device for specific operations within prescribed parameters for a specific geographic location.

Software defined radios present a challenge for equipment certification processes because their specific operational parameters may not be determined until a software profile is loaded into a device. As the term software implies, this new generation of radios is not restricted to operating in the historical structure determined by design and manufacturer constraints. The profiles may vary greatly depending on the flexibility of the software defined radio. One military software defined radio program, the Joint Tactical Radio System (JTRS), has been challenging the equipment certification paradigm for more than a decade. The obvious benefit of this technology is enhanced mission capabilities. The electromagnetic characteristics of JTRS radios are dependent on specific waveform software profiles installed in the hardware platform. The permutation of multiple platforms and multiple waveforms does not fit within the paradigm of a traditional hardware radio with finite operational characteristics.

Cognitive radio systems present a challenge to spectrum management during the frequency assignment process. In its extreme implementation, a cognitive radio system automatically adapts its communication parameters to network and user demands based on its interpretation of available spectrum. As the electromagnetic environment changes, the cognitive radio system's behavior may change as well. Dynamic frequency selection technology is an early indication of a cognitive radio's capabilities for spectrum sensing: detecting the unused spectrum and sharing it without harmful interference with other users. Depending on the local electromagnetic environment, a dynamic frequency selection device will modify its behavior to operate on some frequencies while avoiding others. During the past decade, dynamic frequency selection systems have been introduced into some Wi-Fi technologies. This is a primitive example of cognitive radio systems but, like JTRS, it too has challenged traditional spectrum management practices.

The transformation of spectrum management business processes will be led by the intersection of technological capabilities and regulatory requirements. Spectrum management business processes will harness these two forces to put cognitive radio systems and software defined radios into the hands of warfighters. Procedures for spectrum management will not only adapt to incorporate these new technologies, they will transform as these technologies bring new concepts and capabilities to spectrum management.

U.S. Navy Boatswains Mate 2nd Class Steven Douglas, a native of Helmstedt, Germany, assigned to Beach Master Unit 1st Detachment Western Pacific (BMU1DETWESTPAC), communicates with the lighter amphibious resupply cargo (LARC) vehicle as it performs a hole check Feb 13. The amphibious ready group is underway to support Cobra Gold 2012, the exercise consists of multinational training events executed annually and held throughout the Kingdom of Thailand. Exercise Cobra Gold is the largest multilateral exercise in the Asia-Pacific region, offering more than 20 participating countries opportunities to improve interoperability. U.S. Navy photo by MC2 Eric Crosby.

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Spectrum management business processes must incorporate aspects of behavior enforcement to ensure that the technology acts the way operators want it to in a given situation, as well as support a level of autonomy for the technology to make decisions without human intervention, while enabling configuration management in near real-time. The business process will evolve from a system of strict predetermination toward one based on trust.

Thomas Kidd is the lead for strategic spectrum policy for the Department of the Navy.

TAGS: NEN, Spectrum, Telecommunications, Wireless

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